

Body Mass Index, Weight-for-age, and Stature-for-age Indices in Iranian School Children in Relation to Weight and Growth Disorders: A Population-based Survey

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ABSTRACT

Background: Present study aimed to evaluate the prevalence of grades of nutritional status comprising underweight, normal weight, overweight, and obesity as well as other measurable anthropometric indicators of body mass index (BMI) in regard to gender, educational level, and living area among students settled in Isfahan province.

Methods: This cross-sectional study was conducted on a sample of 4700 individuals (2349 females and 2351 males) being from 9 to 15 years old, while they were students of either primary school or junior high school. Random cluster method was applied in both urban (84%) and rural (16%) areas of Isfahan province. BMI values were measured and then categorized using reference growth charts from the Centers for Disease Control and Prevention (CDC 2000). Weight-for-age and stature-for-age indices were assessed as well in accordance with CDC growth charts.

Results: The overall prevalence of underweight, overweight, and obesity was 13.9, 10.4, and 5.7%, respectively. Boys and students of urban areas showed a higher tendency of obesity and overweight in comparison with girls and rural students respectively. Furthermore, rural students had poorer status in both weight-for-age and stature-for-age indices. In addition, educational level was the only statistically efficacious factor.

Conclusions: This study and previous ones demonstrated that children and adolescents' nutritional status, which strongly affect general health status of individuals, should receive more exquisite attention.

Keywords: Body mass index, child, malnutrition, nutritional status, obesity, overweight

INTRODUCTION

Growth and weight disorders of children are rising to become a global concern in both developed and developing countries; hence, these disorders are subjected to careful scrutiny in recent decades.^[1] Indeed, obesity is substantially a gateway disorder

which leads to numerous chronic diseases and is known to be associated with increased morbidity and mortality,^[2] therefore, it is solely known as a public health burden. Weight disorders, such as obesity, are firmly accompanied with short-term as well as long-term complications while it is affecting children and adolescents. Furthermore, behavioral and biological risk factors which are associated with childhood chronic diseases later could be able to influence adulthood health determinants as well as notable morbidity and mortality they lead to.^[3-5] For example, childhood overweight, not only correlates with adulthood atherosclerosis, hyperinsulinemia and hypertension, but also psychosocial problems.^[6] Moreover, adolescence is a critical period for developing weight disorders like obesity and childhood obesity has been known itself as a predictor of the adulthood overweight.^[7-9] However, during the recent years, children overweight and obesity have doubled in developed and developing countries.^[10,11] Asian countries, Middle East, and Iran are not spared.^[12,13] Some of these countries (such as Iran) have faced diminished physical activities and higher fat intake due to not only rapid process of urbanization, industrialization, and nutritional transition, but also lifestyle changes, which have been implemented during past decades.^[14,15] While the high prevalence of overweight and obesity is established in adult population of developing countries,^[16] corresponding data on this issue and its related social variation among children and adolescents are still sparse.^[17]

Malnutrition and undernutrition of children have imposed double burden of nutritional disorders due to emerging epidemiologic and demographic transition besides overweight disorders in developing countries.^[18] Nonetheless, children weight disorders are not still considered as health priority at national level in developing countries which might be partly explained by the lack of cohesive data from large scale population based studies in these countries and limited existing data on obesity prevalence based on optimum definitions for children of developing countries.^[19]

Iranian national studies implemented on childhood obesity demonstrated that its prevalence in metropolitan areas was high,^[9] whereas this result was not found in other regions.^[20] However,

for better verification of national health priorities this study aims to determine prevalence of different weight categories based on measured anthropometric indicators of body mass index (BMI) amongst a sample of children and adolescent students in Isfahan province (one of the largest provinces in Iran). This survey was implemented in accordance with Center for Disease Control and Prevention (CDC) growth charts and cut-offs.^[21] Furthermore, Isfahan school students were categorized and compared on the base of living area, age and gender variables.

METHODS

The present survey was a cross-sectional study conducted from September 2009 to March 2010 on a sample of 4700 children being from 5 to 15 years old. These individuals were students of either primary schools or junior high schools in Isfahan province (one of the largest provinces of Iran), whereas those who did not settle in Isfahan province and immigrants were excluded. Sample size was based on function assessment questionnaire while 2% attrition was considered.

Students were selected using multistage random cluster sampling and bunches were selected in accordance with student population of different towns of Isfahan province as well as total number of student population in each of the educational levels (either primary or junior high school). In fact, 2867 and 1833 individuals were selected from primary schools and junior high schools, respectively, while samples were collected in rural and urban areas proportionally (16.4% and 83.6% respectively). After providing an explanation of the procedure, the survey team obtained oral assent from the students.

After obtaining informed consent, BMI – as the most common and routinely used measure for child obesity^[22] was measured (by 0.2 scale interval), while individuals were barefoot and lightly dressed. A team of healthcare professionals was trained to conduct the study and all instruments, which include beam scale and nonstretch tape fixed to a flat vertical wall, were standardized and calibrated. The study team recorded age and a number of demographic characteristics; then data were analyzed by SPSS 18 software, (version 18, SPSS Inc., Chicago, IL). BMI cut-offs provided by the CDC were used for the classification of the

pupils as underweight (<5th percentile), normal (5–84th percentile), overweight (85–94th percentile) and obese (≥95th percentile).^[21] The status of mentioned categories was compared in 3 steps according to gender, educational level, and living area. In addition, weight-for-age and stature-for-age estates were also compared while CDC growth charts smoothed percentile curves were applied.

The study protocol was approved by the ethics committee of the Isfahan University of Medical Sciences. Participation in this study was voluntary while information was collected anonymously, and the outcomes were used for research purposes.

RESULTS

This cross-sectional study was performed on a sample of 4700 (2349 females and 2351 males) students of either primary school (70%) or junior high school (30%) aged 9–15 years. Eighty-four percent (3923 students) of participants were from urban areas while the rest 16% (768 participants) settled in rural regions Table 1 showed distribution of students in terms of gender and living area. The prevalence of underweight, normal weight, overweight, and obesity among the participants is described in Table 2 in percentage. The overall prevalence of underweight, overweight and obesity was 13.9, 10.4 and 5.7%, respectively. Almost 70% of pupils had BMIs in normal range; however, obesity and underweight categories were higher in boys and girls, respectively ($P = 0.040$). Thus, BMI values were shown to be influenced by gender. In addition, urban students had a prominent higher tendency towards obesity and overweight while rural ones showed a higher prevalence of underweight ($P < 0.001$). There was not any association between educational level and BMI differences among understudied pupils ($P = 0.093$).

The majority of the students (almost 75%) showed the normal proportion of weight to age index. To elaborate, one-third of the pupils showed some degrees of mild malnutrition, in spite of the fact that severe malnutrition was venial among the students. In fact, neither gender nor educational level showed any association with malnutrition, yet rural participants showed significantly higher malnutrition prevalence in comparison to their urban counterparts ($P < 0.001$).

Table 1: Distribution of students in terms of gender and living area

Living area	Number (%)		
	Total	Rural	Urban
Gender			
Female	2344 (50)	390 (50.8)	1954 (49.8)
Male	2347 (50)	378 (49.2)	1969 (50.2)
Total	4691 (100)	768 (100)	3923 (100)

Table 2: Prevalence of underweight, overweight, and obesity among participants according to gender, age, and educational level

	Underweight (%)	Normal weight (%)	Overweight (%)	Obese (%)
Female	14.2	70.5	10.5	4.7
Male	13.6	69.4	10.3	6.7
<i>P</i>	0.04	>0.05	>0.05	0.04
Urban	12.9	69.9	10.9	6.3
Rural	19.2	70.6	7.5	2.7
<i>P</i>	<0.001	>0.05	<0.001	<0.001
Elementary school	14.9	69.9	9.9	5.7
Junior high school	12.3	70.9	11	5.8
<i>P</i>	>0.05	>0.05	>0.05	>0.05
Total	13.9	70	10.4	5.7

On the other hand, the majority of the population (96.7%) demonstrated normal proportion of stature to age, even though a small proportion of them (3%) showed degrees of short stature. Neither gender nor place of the living had any association with stature; still, educational level and nutritional state were poorer in students of junior high schools ($P = 0.033$). The prevalence of malnutrition is presented in accordance with the proportion of weight-for-age and stature-for-age indices in Table 3.

DISCUSSION

According to the findings of the present study, the overall prevalence of overweight and obesity was 10.4 and 5.7%, respectively, in children aged 9–15 years in Isfahan. In a study, in the west of Iran, the prevalence of obesity in schoolchildren aged 7–12 years was reported to be 9.9%.^[23] In another study on 1000 school children of the same

Table 3: Prevalence of malnutrition states according to weight-for-age and stature-for-age indices among participants

	Total (%)	Female (%)	Male (%)	P	Urban (%)	Rural (%)	P	Elementary school (%)	Junior high school (%)	P
Weight-for-age										
Normal	75	74	76	>0.05	76.8	65.4	>0.05	74.8	75.1	>0.05
Mild malnutrition	21.8	22.8	20.9	>0.05	20.2	30.2	<0.001	22.3	21.1	>0.05
Moderate and severe malnutrition	3.2	3.3	3.9	0.422	3.0	4.3	<0.001	2.9	3.8	0.104
Stature-for-age										
Normal	96.7	96.7	96.7	0.229	97.0	95.5	0.104	97.3	95.8	0.033
Mild, moderate and severe malnutrition	3.3	3.3	3.3	0.229	3.0	4.5	0.104	2.7	4.2	0.033

age conducted in the north of Iran, the prevalence of obesity and overweight was claimed to be 5.8% and 12.3%, respectively,^[24] which did not differ from this study.

However, the prevalence of overweight differed greatly in the other parts of the world. For example, Krassas *et al.* demonstrated that the prevalence of overweight and obesity in Greek students aging from 6 to 17 years was 22.2% and 4.1%, respectively; in addition, similar results were found for overweight and obesity in Costa Rican students (34.5% and 26.2%, respectively,^[25,26] which are higher than what we reported. On the contrary, the prevalence of children and adolescents' overweight in India and Turkey was similar to ours.^[27,28] These differences could be attributed to ethnic, genetic, lifestyle, and environmental variations. Furthermore, different methods and definitions of obesity and underweight as well as various reference values of the studies could cause result's dissimilarities. As with the study of Hajian-Tilaki *et al.*, the overall prevalence of overweight and obesity was higher than underweight, which corroborates the fact that not only Middle Eastern but also Asian countries are challenging childhood overweight and obesity.^[24]

In the present survey, boys were also shown to have significantly higher prevalence of obesity in comparison to girls, yet, the prevalence of underweight was vice versa. Nonetheless, similar and dissimilar findings were attributed in different studies. Some studies have shown such a higher obesity tendency in male children and adolescents,^[25,29] while boys and girls were shown to be similar in some other^[30] or prevalence of obesity was higher in girls in comparison to boys.^[31] It seems that different nutritional behaviors and physical activity of males and females in different cultures, as well as different study methods and

definition of underweight, obesity, and overweight in various studies.

While in our and previous studies, the prevalence of short stature did not differ significantly between two genders,^[32] Pakistani girls showed higher stature.^[33] Furthermore, in a study conducted in South Africa, the prevalence of short stature among 10–14 years girls and boys were 23.7% and 26.7% in rural areas and 11.6% and 17.1% in urban regions respectively.^[34] The mentioned study showed the highest prevalence of malnutrition, according to short stature, among boys and children in rural areas. However, our study showed a poorer state of stature-for-age in junior high school pupils in comparison with their elementary school counterparts; still, living area did not affect pupil's stature. In general, in our study, the prevalence of short stature was nearly 3%, which is considerably lower than the corresponding values reported by similar studies. Thus, ameliorated nutritional status, in comparison with previous studies, is deductible.

In addition, in our study, weight for age index was just significantly affected by living area. Indeed, nutritional status of urban students was better in comparison with rural ones due to lower socioeconomic status in the countryside. Although in some of the other studies on Iranian children, boys were more susceptible to gain higher weight-for-age values,^[31] weight for age indices were not affected by gender variable in the present study.

CONCLUSIONS

There is an increasing trend of childhood obesity and overweight as well as short stature among Isfahan schoolchildren. Thus, not only

consecutive collection of BMI data in different age groups and genders is indispensable, but also crucial interventions preventing serious national health problems are not negligible. Thus, revision of national health strategies focusing on groups of children who need more education or interventions should not be neglected.

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